

Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead

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B.2.9 SOUTHERN CALIFORNIA STEELHEAD

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B.2.9.1 Summary of Previous BRT Conclusions

The geographic range of the ESU was determined to extend from the Santa Maria River basin near the town of Santa Maria, south to the United States border with Mexico. There is a report of *O. mykiss* populations in Baja California del Norte (Ruiz-Campos and Pister 1995); these populations are thought to be resident trout, but could be found to have an anadromous component with further study (note that they do not lie within the jurisdiction of the Endangered Species Act). NMFS (1997) cites reports of several other steelhead populations south of the border. The southern California ESU is the extreme southern limit of the anadromous form of *O. mykiss*. It was separated from steelhead populations to the north on the basis of a general faunal transition (in the fauna of both freshwater and marine systems) in the vicinity of Point Conception. The genetic differentiation of steelhead populations within the ESU, and from other ESUs in northern California or the Pacific Northwest appears to be great; however the conclusion is based on genetic data from a small number of populations.

Summary of major risks and status indicators

Risks and limiting factors—The original BRT noted that there has been extensive loss of populations, especially south of Malibu Creek, due to urbanization, dewatering, channelization of creeks, human-made barriers to migration, and the introduction of exotic fish and riparian plants. Many of these southern-most populations may have originally been marginal or intermittent (i.e. exhibiting repeated local extinctions and recolonizations in bad and good years respectively). No hatchery production exists for the ESU. The relationship between anadromous and resident *O. mykiss* is poorly understood in this region, but likely plays an important role in population dynamics and evolutionary potential of the fish.

Status indicators—Historical data on the ESU were sparse. The historical run size for the ESU was roughly estimated to be at least 32,000-46,000 (estimates for the four systems comprising the Santa Ynez, Ventura, Santa Clara Rivers, and Malibu Creek; this omits the Santa Maria system and points south of Malibu Creek). Recent run sizes for the same four systems were roughly estimated to be less than 500 adults total. No time series data were found for any populations.

Previous BRT conclusions

The original BRT concluded that that ESU was in danger of extinction, noting that populations were extirpated from much of their historical range (Busby et al. 1996). There was strong concern about widespread degradation, destruction, and blockage of freshwater habitats, and concern about stocking of rainbow trout. The two major areas of uncertainty were 1) lack of data on run sizes, past and present; and 2) the relationship between resident and anadromous forms of the species in the region. A second BRT convened for an update (NMFS 1997) found

that the small amount of new data did not suggest that the situation had improved, and the majority view was that the ESU was still in danger of extinction.

Listing status

The ESU was listed as endangered in 1997. The original listing defined the ESU as having its southern geographic limits in Malibu Creek. Two small populations were subsequently discovered south of this point, and in 2002 a notice was published in the Federal Register, extending the range to include all steelhead found in drainages southward to the US border with Mexico.

B.2.9.2 New Data and Updated Analyses

There are four new significant pieces of information: 1) Four years of adult counts in the Santa Clara River; 2) observed recolonizations of vacant watersheds, notably Topanga Creek in Los Angeles county, and San Mateo Creek in Orange county; 3) a comprehensive assessment of the current distribution of *O. mykiss* within the historical range of the ESU (Boughton and Fish MS); and 4) changes in the harvest regulations of the sport fishery. Items (1), (2) and (4) are described further in the analyses section below; item (3) is described here:

Current distribution vs. historical distribution

In 2002, an extensive study was made of steelhead occurrence in most of the coastal drainages within the geographic boundaries of the ESU (Boughton and Fish MS). Steelhead were considered to be present in a basin if adult or juvenile *O. mykiss* were observed in any stream reach that had access to the ocean (i.e. no impassable barriers between the ocean and the survey site), in any of the years 2000-2002 (i.e. within one steelhead generation). Of 46 drainages in which steelhead were known to have occurred historically, between 37% and 43% were still occupied by *O. mykiss*. The range in the estimate of occupancy occurs because a number of basins could not be surveyed due to logistical problems, pollution, or lack of permission to survey on private land. Three basins were considered vacant because they were dry, 17 were considered vacant due to impassable barriers below all spawning habitat; and six were considered vacant because a snorkel survey found no evidence of *O. mykiss*. These snorkel surveys consisted of spot checks in likely-looking habitat and did not involve a comprehensive assessment of each basin.

One of the “dry” basins—San Diego River—may have water in some tributaries—it was difficult to establish that the entire basin below the dam was completely dry. Numerous anecdotal accounts suggest that several of the basins that had complete barriers to anadromy may have landlocked populations of native steelhead/rainbow trout in the upper tributaries. These basins include the San Diego, Otay, San Gabriel, Santa Ana, and San Luis Rey Rivers. Occupancy was also determined for 17 basins with no historical record of steelhead occurrence; none were found to be currently occupied.

Nehlsen et al. (1991) listed the following Southern California stocks as extinct: Gaviota Creek, Rincon Creek, Los Angeles River, San Gabriel River, Santa Ana River, San Diego River, San Luis Rey River, San Mateo Creek, Santa Margarita River, Sweetwater River, and Maria Ygnacio River. The distributional study of 2002 determined that steelhead were present in two

of these systems, namely Gaviota Creek (Stoecker and CCP 2002) and San Mateo Creek (a recent colonization; see below). Nevertheless, the current distribution of steelhead among the basins of the region appears to be substantially less than what occurred historically. Except for the small population in San Mateo Creek in northern San Diego County, the anadromous form of the species appears to be completely extirpated from all systems between the Santa Monica Mountains and the Mexican border. Additional years of observations, either of presence or absence, would reduce the uncertainty of this conclusion.

Table B.2.9.1. Estimates from Busby et al. (1996), for run sizes in the major river systems of the southern steelhead ESU.

River basin	Run size estimate	Year	Reference
Santa Ynez	20,000 – 30,000	Historic	Reavis (1991)
	12,995 – 25,032	1940s	Shapovalov & Taft (1954)
	20,000	Historic	Titus et al (MS)
	20,000	1952	CDFG (1982)
Ventura	4,000-6,000	Historic	AFS (1991)
	4,000-6,000	Historic	Hunt et al. (1992)
	4,000-6,000	Historic	Henke (1994)
	4,000-6,000	Historic	Titus et al. (MS)
Matilija Cr.	2,000 – 2,500	Historic	Clanton & Jarvis (1946)
Santa Clara	7,000 – 9,000	Historic	Moore (1980)
	9,000	Historic	Comstock (1992)
	9,000	Historic	Henke (1994)

Recent colonization events

Several colonization events were reported during the interval 1996-2002. Steelhead colonized Topanga Creek in 1998 and San Mateo Creek in 1997 (R. Dagit, T. Hovey, pers. comm.). As of this writing (October 2002) both colonizations persist although the San Mateo Creek colonization appears to be declining. T. Hovey (CDFG, pers. comm.) used genetic analyses to establish that the colonization in San Mateo Creek was made by two spawning pairs in 1997. In the summer of 2002 a dead mature female was found in the channelized portion of the San Gabriel River in the Los Angeles area (M. Larsen, CDFG, pers. comm.). A single live adult was found trapped and over-summering in a small watered stretch of Arroyo Sequit in the Santa Monica Mountains (K. Pipal and D. Boughton, UCSC and NMFS, pers. comm.). The “run sizes” of these colonization attempts are of the same order as recent “run sizes” in the Santa Clara system—namely, less than five adults per year. Each of the four colonization events reported above occurred in a basin in which the presence of steelhead had been documented historically (Titus et al. MS).

Two significant analyses exist: 1) A critical review of the historical run sizes cited in the previous status review, and 2) A few new data on run size and population distribution in three of the larger basins.

Review of historical run sizes

Few quantitative data exist on historical run sizes of southern steelhead. Based on the available information at the time, the previous status review made rough estimates for three of the large river systems (Table B.2.9.1), and a few of the smaller ones (Busby et al. 1996).

The Santa Ynez.—The run size in the Santa Ynez system—probably the largest run historically—was estimated to originally lie between 20,000 and 30,000 spawners (Busby et al. 1996). This estimate was based primarily on four references cited in the status review: Reavis (1991) (20,000-30,000 spawners), Titus et al. (MS) (20,000 spawners), Shapovalov and Taft (1954) (12,995-25,032 spawners), and CDFG (1982) (20,000 spawners). Examination of these references revealed the following: Reavis (1991) asserted a run size of 20,000-30,000, but provided no supporting evidence. Titus et al. (MS) reviewed evidence described by Shapovalov (1944), to be described below. Shapovalov and Taft (1954) did not address run sizes in this geographic region; the citation is probably a mis-citation for Shapovalov (1944). CDFG (1982) makes no reference to salmonid fishes in southern California.

Entrix (1995) argued that the estimate of 20,000 – 30,000 is too large. They argued that the only direct observations of run size are from Shapovalov (1944), an assertion that appears to be correct. These data are based on a CDFG employee's visual estimate that the 1944 run was “at least as large” as runs in the Eel River (northern California), which the employee had observed in previous years. Estimated run sizes for the Eel River ranged between 12,995 and 25,032 during the years 1939 to 1944 (Shapovalov 1944), and this has thus been reported as the estimated run size of the Santa Ynez. Entrix (1995) observed, however, that the employee who made the comparison was only present at the Eel River during two seasons, 1938-39 and 1939-40. The estimates for run sizes in those years were 12,995 and 14,476 respectively, which suggests that a more realistic estimate for the Santa Ynez run of 1944 would be 13,000-14,500. Taking this chain of reasoning to its logical conclusion, the range 13,000 – 14,500 should be regarded as a minimum run size for the year in question, since the employee used the phrase “at least as large.”

It is perhaps useful to place the year 1944 in context, since expert opinion about run size is based solely on observations made in that year. Entrix (1995) report that 1944 occurred toward the end of a wet period, which may have provided especially favorable spawning and rearing conditions for steelhead. Rainfall data from Santa Barbara County's historical records give a different picture from Entrix (1995): only two of the preceding eight years (1940 and 1943) were wetter than the 107-year average for the area (M. Capelli, person. comm.). 1944 was near average; otherwise rainfall was below average.

In addition, the year 1944 seems to have occurred toward the end of a period in which extensive rescues of juvenile steelhead had been made during low-flow years (Shapovalov 1944, Titus et al. MS). Over the interval 1939-1946, a total of 4.3 million juveniles were rescued from drying portions of the mainstem, and usually replanted elsewhere in the system. This averages to about 61,400 juveniles rescued per year. Assuming that rescue operations lowered the mean mortality rate as intended, during the 1939-1946 interval the Santa Ynez population may have increased somewhat (or failed to undergo a decline) due to the rescue operations. A rough estimate of magnitude can be made: Assuming deterministic population growth (as opposed to stochastic), and a survival to spawning of about 1%, the rescues would have increased the run size by about 4% per generation. High environmental stochasticity in survival of the rescued fish and in the overall population growth—which almost certainly was the case—would have reduced the effect size to be much lower than 4%.

There is a counter argument to the argument that the 1944 estimate is too high; namely that it is too low. The estimate was not made until 24 years after a significant proportion of spawning and rearing habitat had been blocked behind dams. The Santa Ynez system currently has three major dams on the mainstem that block portions of spawning and rearing habitat. The middle dam (Gibraltar) was built in 1920, and blocked access to 721 kilometers of stream, much of which was widely regarded to be high-quality spawning and rearing habitat (Table B.5.1.1; Titus et al MS). At that time, no estimates of run size had been made for the Santa Ynez. An upper dam (Juncal) was constructed in 1930 and may have had a negative effect on run size through reduction of flows to the lower mainstem. Only the lower dam (Cachuma or Bradbury) was built late enough (1953) to not cause the 1944 estimate to be a biased estimate of historical run size.

Ventura.—According to Titus et al. (MS), the Ventura River was estimated to have a run size of 4,000-5,000 adults during a normal water year. This estimate was made in 1946, although it is likely that the estimate is an expert opinion based on numerous years of observation. The system had received numerous plantings of juveniles in the preceding period (27,200 in 1943, 20,800 in 1944, and 45,440 in 1945, as well as 40,000 in 1930, 34,000 in 1931, and 15,000 in 1938). These rescues probably had small effect, for similar reason as those cited above for the Santa Ynez. As in the Santa Ynez, anecdotal accounts suggest that run sizes declined precipitously during the late 1940s and 1950s, due possibly to both drought and to anthropogenic changes to the river system such as dam construction. Similar considerations apply to the estimate made by Clanton and Jarvis (1946), of 2,000-2,500 adults in the Matilija basin, a major tributary of the Ventura River.

Santa Clara.—Moore's (1980) estimate of 9,000 spawners in the Santa Clara basin is an extrapolation of the estimate of Clanton and Jarvis' (1946) estimate for Matilija Creek. He assumed similar levels of production per stream mile in the two systems, and noted that at least five-times more spawning and rearing habitat exists in the Santa Clara. Moore (1980) regarded his estimate as biased downward, because although it included the major spawning areas (Santa Paula, Sespe, and Piru creeks), it omitted numerous small side-tributaries.

Ed Henke (cited in NMFS 1997) stated that abundance of steelhead in the Southern California ESU was probably about 250,000 adults prior to European settlement of the region. His argument is based on historical methods of research involving interviews of older residents of the area as well as written records. The original analysis producing the cited estimate is part of ongoing research and was not made available for review at the time of this writing (E. Henke, pers. comm.).

In summary, the estimates of historical run sizes for this steelhead ESU are based on very sparse data and long chains of assumptions that are plausible but have not been adequately tested. It seems reasonable to say that the existing estimates are biased upward or downward by some unknown amount. It is certainly clear from the historical record that adult run sizes of the past could be 2 or 3 orders of magnitude greater in size than those of recent years, but the long-term mean or variance in run size is not known with any reasonable precision at all. Assuming that spawning and rearing success are related to rainfall, the variance between years was likely high due to climatic variability in southern California; and variance among decades high due to the Pacific Decadal Oscillation. In addition, long-term climate change in the region likely causes

the running mean of run size (whatever it may be) to exhibit drift over time. If one were to be interested in the true potential productivity of these systems, much would be learned by some targeted field studies on the current habitat-productivity relationships for the fish, and by studies of the influence of climate, water management practices, and their interaction. It does not seem likely that further historical research will turn up information useful for making more refined estimates, despite the fact that it is useful for determining where exactly the fish occurred.

Recent run sizes of large river systems

It seems likely that the larger river systems were originally the mainstay of the ESU. Large river systems that harbored steelhead populations in the past are (from north to south) the Santa Maria, the Santa Ynez, the Ventura, the Santa Clara, the Los Angeles, the San Gabriel, the Santa Ana, and possibly the San Diego. Of these eight systems, the data suggest that steelhead currently occur in only four—the Santa Maria, Santa Ynez, Ventura, and Santa Clara.

The Santa Maria—There do not appear to be any estimates for recent run sizes in the Santa Maria system. Twitchell Dam blocks access to a significant proportion of historical spawning habitat, the Cuyama River, one of the two major branches of the Santa Maria. The other major branch, the Sisquoc River, appears to still have substantial spawning and rearing habitat that is accessible from the ocean; juvenile steelhead have recently been observed in these areas (Cardenas 1996, Kevin Cooper, Los Padres NF, pers. comm.).

The Santa Ynez—Most of the historical spawning habitat is blocked by Cachuma and Gibraltar Dams. However, extensive documentation exists for steelhead/rainbow trout populations in a number of ocean-accessible sites below Cachuma dam (Table B.2.9.2). These are Salsipuedes/El Jaro Creeks, Hilton Creek, Alisal Creek, Quiota Creek, San Miguelito Creek, and three reaches in the mainstem (Hanson 1996, Engblom 1997, 1999, 2001). Various life stages of steelhead, including upstream migrants and smolts, have been consistently observed at some of these sites (see Table B.2.9.2), suggesting the occurrence of persistent populations. Run sizes are unknown, but likely small (<100 adults total), implying the populations are not viable over the long term. A third dam, Juncal Dam, occurs above the other two dam in the watershed, and is reported to support a small population of land-locked steelhead that annually enter the reservoirs' tributaries to spawn (M. Capelli, pers. comm.)

The Ventura—There are no estimates of recent run sizes in the Ventura River. Casitas Dam on Coyote Creek and Matilija Dam on Matilija Creek block access to significant portions of the historical spawning habitat. There are recent individual reports of sightings of steelhead in the Ventura River and San Antonio Creek (M Capelli, 1997; C. Zimmerman 2000, 2001), but no quantitative estimates.

The Santa Clara—A few estimates of recent run sizes exist for the Santa Clara system, due to the presence of a fish ladder and counting trap at the Vern Freeman Diversion Dam on the mainstem. This diversion dam lies between the ocean and what is widely believed to be one of the largest extant populations of steelhead in the ESU (the Sespe Canyon population). The run size of upstream migrants was one adult in each of 1994 and 1995, two adults in 1996, and no adults in 1997. No data have been collected since that date, and the fish ladder is thought to be dysfunctional.

Harvest impacts

Since the original status review of Busby et al. (1996), regulations concerning sport fishing have been changed in a way that may potentially reduce extinction risk for the ESU.

Sport harvest of steelhead in the ocean is currently prohibited by the California Department of Fish and Game (CDFG 2002a), and ocean harvest is a rare event (M. Mohr, NMFS, pers. comm.). For freshwaters (CDFG 2002b), summer-fall catch-and-release angling is allowed in Piru Creek below the dam; San Juan Creek (Orange County); San Mateo Creek (one section); Santa Margarita River and tributaries; and Topanga Creek. Year-round catch and release is allowed in the San Gabriel River (below Cogswell Dam); and Sespe Creek and tributaries. All the above are historical steelhead streams and many of the stretches open to fishing are potentially used both by anadromous runs and by resident populations.

Year-round trout fisheries are allowed in Calleguas Creek and tributaries (limit 5); Piru Creek above the dam (limit 2); San Luis Rey River (limit 5); Santa Paula Creek above the falls (limit 5); the Santa Ynez River above Gibraltar Dam (limit 2); Sisquoc River (limit 5); and Sweetwater River (limit 5). With the exception of the Sisquoc River, these take-fisheries appear to be isolated from the ocean by natural or human-made barriers. Except for Calleguas Creek and possibly the Sweetwater, the above drainages are listed as historical steelhead streams by Titus et al. (MS). It is certainly possible and indeed likely that some currently harbor native trout with the potential to exhibit anadromy.

At catch-and-release streams, all wild steelhead must be released unharmed. There are significant restrictions on gear used for angling. The CDFG monitors angling effort and catch-per-unit-effort in selected basins by way of a “report card” system in which sport anglers self-report their catch, gear used, and so forth, and in selected other basins by way of creel censuses.

Although the closure of many areas, and institution of catch-and-release elsewhere, is expected to reduce extinction risk for the ESU, this risk reduction cannot be estimated quantitatively from the existing datasets (due to the fact that natural abundance is not being estimated). After the Federal listing decisions, NMFS requested that CDFG prepare a Fishery Management and Evaluation Plan (FMEP) for the listed steelhead ESUs in California. This has not yet been done for the southern California ESU, so the rationale for the set of regulations summarized above is not transparent.

Resident *O. mykiss* considerations

Resident (non-anadromous) populations of *O. mykiss* were assigned to one of three categories for the purpose of provisionally determining ESU membership (See “Resident Fish” in the introduction for a description of the three categories and default assumptions about ESU membership). The third category consists of resident populations that are separated from anadromous conspecifics by recent human-made barriers such as dams without fish ladders. No default assumption about ESU membership was possible for Category 3 populations, so they are here considered case-by-case according to available information.

As of this writing there are few data on occurrence of resident populations and even fewer on genetic relationships. A provisional survey of the occurrence of Category 3 populations

in the ESU (see Table B.5.1.1) revealed the following: There are numerous Category 3 populations within the original geographic range of the Southern California ESU. All of the larger watersheds originally inhabited by the ESU now have major barriers completely blocking substantial portions of habitat (Table B.5.1.1; a major barrier is defined as a complete barrier to migration that has greater than 100 sq. mi. of watershed area lying above it). In the watershed of the Santa Maria River, 71% of total stream kilometers are above Twitchell Dam. The Santa Clara watershed has 99% of stream kilometers above Vern Freeman diversion dam. This facility has a fish ladder, but the ladder is currently dysfunctional due to channel migration which has disconnected the ladder intake from the river's thalweg, combined with deficient quantities and configurations of water releases through the facility (M. Whitman, CDFG hydraulic engineer, personal communication). The Santa Ynez watershed, which probably originally harbored the strongest run of steelhead in the southern California ESU, has 58% of its stream kilometers above Cachuma dam. In each of these cases the historical record has reports of steelhead ascending to and spawning in areas that are now blocked behind the above-mentioned dams (Titus et al. 2003). In the case of the Santa Ynez, adult *O. mykiss* have been observed to make "steelhead-like" runs from the uppermost reservoir (behind Juncal dam) into the North Fork Juncal and the upper Santa Ynez for at least the past seven years (personal communication, Louis Andolora, dam tender at Juncal).

All the large watersheds further south have major barriers blocking substantial portions of stream habitat. Consequently, in the set of major watersheds originally inhabited by the ESU, at least 48% of stream kilometers are now behind barriers impassable to anadromous fish (the value is probably somewhat higher due to minor barriers not considered in Table B.5.1.1). At least 11 of these 15 major watersheds are known to have resident populations above the barriers (Table B.5.1.1).

We do not know much about the genetic relationships of these resident populations. There is one study of genetic relationships among hatchery stocks, anadromous fish, and resident populations above barriers (Nielsen et al. 1997). The study used selectively-neutral genetic markers to assess genetic distances among the various categories of fish (anadromous, residualized, hatchery, etc.) but the results were inconclusive. However, according to the provisional survey described in Table B.5.1.1, at least 7 of the 11 watersheds with resident populations above major barriers are currently being stocked with hatchery fish. It is not clear whether these stocked fish have successfully interbred with the native fish; whether such interbreeding would have led to significant gene flow between the introduced and native fish; or to what extent the local adaptations of the native fish would have been maintained by selection even if gene flow occurred.

Table B.2.9.2. Presence of steelhead in the lower Santa Ynez River system (*caught in upstream migrant trap).

Tributary	Redds	<6"	>6"	Smolts	Adults	Unspec	Year (spr.)	Source
Salsipuedes/El Jaro		Y	Y	Y	Y*		1994	Hanson 1996
				Y	Y*		1995	Hanson 1996
	Y	Y	Y	Y	Y*		1996	Hanson 1996, Engblom 1997
	Y	Y	Y	Y	Y*		1997	Engblom 1997
	Y	Y	Y		Y*		1998	Engblom 1999
	Y	Y	Y		Y*		1999	Engblom 1999
					Y*		2000	Engblom 2001
		Y	Y	Y	Y*		2001	Engblom 2001
Hilton Creek		N	N		Y*		1994	Hanson 1996
		Y	Y*	Y	Y*		1995	Hanson 1996
				N	Y*		1996	Hanson 1996, Engblom 1997
	N	Y	Y	N	Y*		1997	Engblom 1997
	Y	Y			Y*		1998	Engblom 1999
					N*		1999	Engblom 1999
		Y	Y		Y*		2001	Engblom 2001
Alisal Creek		Y	Y		Y*		1995	Hanson 1996
Nojoqui Creek		N	N		N*		1994	Hanson 1996
				N	N*		1995	Hanson 1996
				N			1997	Engblom 1997
		N	Y		Y*		1998	Engblom 1999
					N*		1999	Engblom 1999
Quiota Creek (& trib)	Y		Y		N*		1995	Hanson 1996
		Y	Y				1994	Hanson 1996
		Y					1998	Engblom 1999
		Y	Y				2001	Engblom 2001
San Miguelito Creek		Y	Y				1996	Hanson 1996
	Y			Y			1997	Engblom 1997
		Y		N	N*		1998	Engblom 1999
	Y			N	N*		1999	Engblom 1999
Mainstem/Hwy 154		Y	Y				1995	Hanson 1996
		Y	Y				1996	Hanson 1996
					Y		1994	Hanson 1996
		Y	Y				1998	Engblom 1999
	Y						1999	Engblom 1999
		Y	Y				2001	Engblom 2001
Mainstem/Refugio		Y	Y				1995	Hanson 1996
		N	Y				1996	Hanson 1996
		Y	Y				1998	Engblom 1999
	Y	N	Y				1999	Engblom 1999
		Y	Y				2001	Engblom 2001
Mainstem/Alisal reach		Y	Y				1995	Hanson 1996
		N	Y				1996	Hanson 1996
		Y	Y				1998	Engblom 1999
		Y	Y				1999	Engblom 1999
		Y	Y				2001	Engblom 2001
Mainstem/Cargasachi		N	N				1995	Hanson 1996
		N	N				1996	Hanson 1996

B.3 STEELHEAD BRT CONCLUSIONS

The ESA (Sec. 3) allows listing of “species, subspecies, and distinct population segments.” The option to list subspecies is not available for Pacific salmon, since no formally recognized subspecies exist. However, a number of subspecies have been identified for *O. mykiss*, including two that occur in North America and have anadromous populations. According to Behnke (1992), *O. mykiss irideus* (the “coastal” subspecies) includes coastal populations from Alaska to California (including the Sacramento River), while *O. mykiss gairdneri* (the “inland” subspecies) includes populations from the interior Columbia, Snake and Fraser Rivers. Both subspecies thus include populations within the geographic range of this updated status review, but both also include northern populations outside the geographic range considered here. The BRT did not attempt to evaluate extinction risk to *O. mykiss* at the species or subspecies level; instead, we evaluated risk at the distinct population segment (ESU) level, as for the other species considered in this report.

Snake River steelhead ESU

A majority (over 70%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with small minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table B.3.1). The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories (mean risk matrix scores ranged from 2.5 for spatial structure to 3.2 for growth rate/productivity) (Table B.3.2). The continuing depressed status of B-run populations was a particular concern. Paucity of information on adult spawning escapements to specific tributary production areas makes a quantitative assessment of viability for this ESU difficult. As indicated in previous status reviews, the BRT remained concerned about the replacement of naturally produced fish by hatchery fish in this ESU; naturally produced fish now make up only a small fraction of the total adult run. Again, lack of key information considerably complicates the risk analysis. Although several large production hatcheries for steelhead occur throughout this ESU, relatively few data exist regarding the numbers and relative distribution of hatchery fish that spawn naturally, or the consequences of such spawnings when they do occur.

On a more positive note, sharp upturns in 2000 and 2001 in adult returns in some populations and evidence for high smolt-adult survival indicate that populations in this ESU are still capable of responding to favorable environmental conditions. In spite of the recent increases, however, abundance in most populations for which there are adequate data are well below interim recovery targets (NMFS 2002).

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in the Palouse and Malad Rivers) are not. Recent genetic data suggest that native resident *O. mykiss* above Dworshak Dam on the North Fork Clearwater River should be considered part of this ESU, but hatchery rainbow trout that have been introduced to that and other areas would not. The BRT did not attempt to resolve the ESU status of resident fish residing above the Hell’s Canyon Dam complex, as little new information is available relevant to this issue. However, Kostow (2003) suggested that,

based on substantial ecological differences in habitat, the anadromous *O. mykiss* that historically occupied basins upstream of Hells Canyon (e.g., Powder, Burnt, Malheur, Owhyee rivers) may have been in a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

Upper Columbia River steelhead ESU

A slight majority (54%) of the BRT votes for this ESU fell in the “danger of extinction” category, with most of the rest falling in the “likely to become endangered” category (Table B.3.1). The most serious risk identified for this ESU was growth rate/productivity (mean score 4.3); scores for the other VSP factors were also relatively high, ranging from 3.1 (spatial structure) to 3.6 (diversity) (Table B.3.2). The last 2-3 years have seen an encouraging increase in the number of naturally produced fish in this ESU. However, the recent mean abundance in the major basins is still only a fraction of interim recovery targets (NMFS 2002). Furthermore, overall adult returns are still dominated by hatchery fish, and detailed information is lacking regarding productivity of natural populations. The ratio of naturally produced adults to the number of parental spawners (including hatchery fish) remains low for upper Columbia steelhead. The BRT did not find data to suggest that the extremely low replacement rate of naturally spawning fish (estimated adult: adult ratio was only 0.25-0.3 at the time of the last status review update) has improved substantially.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in the Entiat, Methow, and perhaps Okanogan basins) are not. Resident fish potentially occur in all areas in the ESU used by steelhead. Case 3 resident fish above Conconully Dam are of uncertain ESU affinity. The BRT did not attempt to resolve the ESU status of resident fish residing above Grand Coulee Dam, as little new information is available relevant to this issue. Possible ESU scenarios for these fish include 1) they were historically part of the ESU and many of the remnant resident populations still are part of this ESU; 2) they were historically part of the ESU but no longer are, due to either introductions of hatchery rainbow trout or rapid evolution in a novel environment; or 3) they were historically part of a separate ESU. For many BRT members, the presence of relatively numerous resident fish mitigated the assessment of extinction risk for the ESU as a whole.

Middle Columbia River steelhead ESU

A slight majority (51%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with a substantial minority (49%) falling in the “not likely to become endangered” category (Table B.3.1). The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories (mean risk matrix scores ranged from 2.5 for diversity to 2.7 for abundance) (Table B.3.2).

This ESU proved difficult to evaluate for two reasons. First, the status of different populations within the ESU varies greatly. On the one hand the abundance in two major basins, the Deschutes and John Day, is relatively high and over the last five years is close to or slightly

over the interim recovery targets (NMFS 2002). On the other hand, steelhead in the Yakima basin, once a large producer of steelhead, remain severely depressed (10% of the interim recovery target), in spite of increases in the last 2 years. Furthermore, in recent years escapement to spawning grounds in the Deschutes River has been dominated by stray, out-of-basin (and largely out-of-ESU) fish—which raises substantial questions about genetic integrity and productivity of the Deschutes population. The John Day is the only basin of substantial size in which production is clearly driven by natural spawners. For the other major basin in the ESU (the Klickitat), no quantitative abundance information is available. The other difficult issue centered on how to evaluate contribution of resident fish, which according to Kostow (2003) and other sources are very common in this ESU and may greatly outnumber anadromous fish. The BRT concluded that the relatively abundant and widely distributed resident fish mitigated extinction risk in this ESU somewhat. However, due to significant threats to the anadromous component the majority of BRT members concluded the ESU was likely to become endangered.

Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in Deschutes and John Day basins) are not. Case 3 resident fish above Condit Dam in the Little White Salmon; above Pelton and Round Butte Dams (but below natural barriers) in the Deschutes; and above irrigation dams in the Umatilla Rivers are of uncertain ESU status.

Lower Columbia River steelhead ESU

A large majority (over 79%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with small minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table B.3.1). The BRT found moderate risks in all the VSP categories, with mean risk matrix scores ranging from 2.7 for spatial structure to 3.3 for both abundance and growth rate/productivity) (Table B.3.2). All of the major risk factors identified by previous BRTs still remain. Most populations are at relatively low abundance, and those with adequate data for modeling are estimated to have a relatively high extinction probability. Some populations, particularly summer run, have shown higher returns in the last 2-3 years. The Willamette Lower Columbia River TRT (Myers et al. 2002) has estimated that at least four historical populations are now extinct. The hatchery contribution to natural spawning remains high in many populations.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of this ESU, while those above long-standing natural barriers (e.g., in upper Clackamas, Sandy, and some of the small tributaries of the Columbia River Gorge) are not. Case 3 resident fish above dams on the Cowlitz, Lewis, and Sandy Rivers are of uncertain ESU status.

Upper Willamette River steelhead ESU

The majority (over 76%) of the BRT votes for this ESU fell in the “likely to become endangered” category, with small minorities falling in the “danger of extinction” and “not likely to become endangered” categories (Table B.3.1). The BRT did not identify any extreme risks for this ESU but found moderate risks in all the VSP categories (mean risk matrix scores ranged from 2.6 for diversity to 2.9 for both spatial structure and growth rate/productivity) (Table B.3.2). On a positive note, after a decade in which overall abundance (Willamette Falls count) hovered around the lowest levels on record, adult returns for 2001 and 2002 were up significantly, on par with levels seen in the 1980s. Still, the total abundance is small for an entire ESU, resulting in a number of populations that are each at relatively low abundance. The recent increases are encouraging but it is uncertain whether they can be sustained. The BRT considered it a positive sign that releases of the “early” winter-run hatchery population have been discontinued, but remained concerned that releases of non-native summer-run steelhead continue.

Because coastal cutthroat trout is a dominant species in the basin, resident *O. mykiss* are not as widespread here as in areas east of the Cascades. Resident fish below barriers are found in the Pudding/Molalla, Lower Santiam, Calapooia, and Tualatin drainages, and these would be considered part of the steelhead ESU based on the provisional framework discussed in the general Introduction. Resident fish above Big Cliff and Detroit Dams on the North Fork Santiam and above Green Peter Dam on the South Fork Santiam are of uncertain ESU affinity. Although no obvious physical barrier separates populations upstream of the Calapooia from those lower in the basin, resident *O. mykiss* in these upper reaches of the Willamette basin are quite distinctive both phenotypically and genetically and are not considered part of the steelhead ESU.

Northern California steelhead ESU

The majority (74%) of BRT votes were for “likely to become endangered,” with the remaining votes split about equally between “in danger of extinction” and “not warranted” (Table B.3.1). Abundance and productivity were of some concern (scores of 3.7; 3.3 in the risk matrix); spatial structure and diversity were of lower concern (scores of 2.2; 2.5); although at least one BRT member gave scores as high as 4 for each of these risk metrics (Table B.3.2).

The BRT considered the lack of data for this ESU to be a source of risk due to uncertainty. The lack of recent data is particularly acute for winter runs. While there are older data for several of the larger river systems that imply run sizes became much reduced since the early twentieth century, there are no recent data suggesting much of an improvement.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the Northern California Coast Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Robert W. Matthews Dam on the Mad River and Scott Dam on the Eel River--but below natural barriers are of uncertain ESU affinity. In this ESU, the inclusion of resident fish would not greatly increase the total numbers of fish, and the resident fish have not been exposed to large amounts of hatchery stocking.

Central California Coast steelhead ESU

The majority (69%) of BRT votes were for “likely to become endangered,” and another 25% were for “in danger of extinction” (Table B.3.1). Abundance and productivity were of relatively high concern (mean score of 3.9 for each, with a range of 3 to 5 for each), and spatial structure was also of concern (score 3.6) (Table B.3.2). Predation by pinnipeds at river mouths and during the ocean phase was noted as a recent development posing significant risk.

There were no time-series data for this ESU. A variety of evidence suggested the largest run in the ESU (the Russian River winter steelhead run) has been reduced in size and continues to be reduced in size. Concern was also expressed about the populations in the southern part of the range of the ESU--notably populations in Santa Cruz County and the South Bay area.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the Central California Coast Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Warm Springs Dam on Dry Creek, Russian River; Coyote Dam on the East Fork Russian River; Seeger Dam on Lagunitas Creek; Peters Dam on Nicasio Creek, Lagunitas Creek; and Standish Dam on Coyote Creek--but below natural barriers are of uncertain ESU affinity. In this ESU, an estimated 22% of historical habitat is behind recent barriers. The only relevant biological information about the populations above these barriers pertains to Alameda Creek, and suggests that some but not all populations above Dam 1 are genetically similar to populations within the ESU. For some BRT members, the presence of resident fish mitigated the assessment of extinction risk for the ESU as a whole.

South-Central California Coast steelhead ESU

The majority (68%) of BRT votes were for “likely to become endangered,” and another 25% were for “in danger of extinction” (Table B.3.1). The strongest concern was for spatial structure (score 3.9; range 3-5), but abundance and productivity were also a concern (Table B.3.2). The cessation of plants to the ESU from the Big Creek Hatchery (Central Coast ESU) was noted as a positive development, whereas continued predation from sport fishers was considered a negative development.

New data suggests that populations of steelhead exist in most of the streams within the geographic boundaries of the ESU; however, the BRT was concerned that the two largest river systems—the Pajaro and Salinas basins—are much degraded and have steelhead runs much reduced in size. Concern was also expressed about the fact that these two large systems are ecologically distinct from the populations in the Big Sur area and San Luis Obispo County, and thus their degradation affects spatial structure and diversity of the ESU. Much discussion centered on the dataset from the Carmel River, including the effects of the drought in the 1980s, the current dependence of the population on intensive management of the river system, and the vulnerability of the population to future droughts.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the South-Central California Coast Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including San Antonia, Nacimiento, and Salinas dams on the Salinas River; Los Padres Dam on the Carmel River; Whale Rock Dam on Old Creek; and Lopez Dam on Arroyo Grande Creek--but below natural barriers are of uncertain ESU affinity. In this ESU, little of the historical habitat is behind recent barriers and most of that on the Salinas River. For some BRT members, the presence of resident fish mitigated the assessment of extinction risk for the ESU as a whole.

Southern California steelhead ESU

The majority (81%) of BRT votes were for “in danger of extinction,” with the remaining 19% of votes being for “likely to become endangered” (Table B.3.1). Extremely strong concern was expressed for abundance, productivity, and spatial structure (mean scores of 4.8, 4.3, and 4.8, respectively, in the risk matrix), and diversity was also of concern (mean score of 3.6) (Table B.3.2).

The BRT expressed concern about the lack of data on this ESU, about uncertainty as to the metapopulation dynamics in the southern part of the range of the ESU, and about the fish’s nearly complete extirpation from the southern part of the range. Several members were concerned and uncertain about the relationship between the population in Sespe Canyon, which is supposedly a sizeable population, and the small run size passing through the Santa Clara River, which connects the Sespe to the ocean. There was some skepticism that flows in the Santa Maria River were sufficient to allow fish passage from the ocean to the Sisquoc River, another “stronghold” of *O. mykiss* in the ESU.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the South California Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Twitchell Dam on the Cuyama River; Bradbury Dam on the Santa Ynez River; Casitas Dam on Coyote Creek, Ventura River; Matilija Dam on Matilija Creek, Ventura River; Santa Felicia Dam on Piru Creek, Santa Clara River; and Casitac Dam on Casitac Creek, Santa Clara River--but below natural barriers are of uncertain ESU affinity. In this ESU, a large portion of the original area is behind barriers, and the few density estimates that are available from this ESU indicate that the inclusion of area above recent barriers would substantially increase the number of fish in the ESU. Due to the extremely low numbers of anadromous fish in this ESU, it is possible that above-barrier populations contribute a significant number of fish to the below-barrier population by spill over. For some BRT members, the presence of resident fish mitigated the assessment of extinction risk for the ESU as a whole.

California Central Valley steelhead ESU

The majority (66%) of BRT votes were for “in danger of extinction”, and the remainder was for “likely to become endangered” (Table B.3.1). Abundance, productivity and spatial structure were of highest concern (4.2-4.4), although diversity considerations were of significant concern (3.6) (Table B.3.2). All categories received a 5 from at least one BRT member.

The BRT was highly concerned by the fact that what little new information was available indicated that the monotonic decline in total abundance and in the proportion of wild fish in the ESU was continuing. Other major concerns included the loss of the vast majority of historical spawning areas above impassable dams, the lack of any steelhead-specific status monitoring, and the significant production of out-of-ESU steelhead by the Nimbus and Mokelumne River fish hatcheries. The BRT viewed the anadromous life-history form as a critical component of diversity within the ESU and did not place much importance on sparse information suggesting widespread and abundant *O. mykiss* populations in areas above impassable dams. Dams both reduce the scope for expression of the anadromous life-history form, thereby greatly reducing the abundance of anadromous *O. mykiss*, and prevent exchange of migrants among resident populations, a process presumably mediated by anadromous fish.

Based on the provisional framework discussed in the general Introduction to this report, the BRT assumed as a working hypothesis that resident fish below historical barriers are part of the California Central Valley Steelhead ESU, while those above long-standing natural barriers are not. Historically, resident fish are believed to have occurred in all areas in the ESU used by steelhead, although current distribution is more restricted. Resident fish above recent (usually man-made) barriers--including Shasta Dam on the Upper Sacramento River; Whiskeytown Dam on Clear Creek; Black Butte Dam on Stony Creek; Oroville Dam on the Feather River; Englebright Dam on the Yuba River; Camp Far West Dam on the Bear River; Nimbus Dam on the American River; Commanche Dam on the Mokelumne River; New Hogan Dam on the Calaveras River; Goodwin Dam on the Stanislaus River; La Grange Dam on the Tuolumne River; and Crocker Diversion Dam on the Merced River--but below natural barriers are of uncertain ESU affinity. As noted above, collectively these dams have isolated a large fraction of historical steelhead habitat, and resident fish above the dams may outnumber ESU fish from below the dams.

Table B.3.1. Tally of FEMAT vote distribution regarding the status of 10 steelhead ESUs reviewed. Each of 16 BRT members allocated 10 points among the three status categories.

ESU	Danger of Extinction	Likely to Become Endangered	Not Likely to Become Endangered
Snake River ¹	14	103	23
Upper Columbia ¹	75	62	3
Middle Columbia ¹	1	71	68
Lower Columbia ²	10	110	30
Upper Willamette ²	7	106	37
Northern California	18	119	23
Central California Coast	40	111	9
South Central California	40	109	11
Southern California	129	31	0
Central Valley	106	54	0

¹ Votes tallied for 14 BRT members

² Votes tallied for 15 BRT members

Table B.3.2. Summary of risk scores (1 = low to 5 = high) for four VSP categories (see section "Factors Considered in Status Assessments" for a description of the risk categories) for the 10 steelhead ESUs reviewed. Data presented are means (range).

ESU	Abundance	Growth Rate/Productivity	Spatial Structure and Connectivity	Diversity
Snake River	3.1 (2-4)	3.2 (2-4)	2.5 (1-4)	3.1 (2-4)
Upper Columbia	3.5 (2-4)	4.3 (3-5)	3.1 (2-4)	3.6 (2-5)
Middle Columbia	2.7 (2-4)	2.6 (2-3)	2.6 (2-4)	2.5 (2-4)
Lower Columbia	3.3 (2-5)	3.3 (3-4)	2.7 (2-4)	3.0 (2-4)
Upper Willamette	2.8 (2-4)	2.9 (2-4)	2.9 (2-4)	2.6 (2-3)
Northern California	3.7 (3-5)	3.3 (2-4)	2.2 (1-4)	2.5 (1-4)
Central California Coast	3.9 (3-5)	3.9 (3-5)	3.6 (2-5)	2.8 (2-4)
South Central California	3.7 (2-5)	3.3 (2-4)	3.9 (3-5)	2.9 (2-4)
Southern California	4.8 (4-5)	4.3 (3-5)	4.8 (4-5)	3.6 (2-5)
Central Valley	4.4 (4-5)	4.3 (4-3)	4.2 (2-5)	3.6 (2-5)

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